

Attorney Docket No.: 130013/11921 (21635-0116)
Application No.: 10/735,370

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: ACKERMAN et al. : Confirmation No.: 1818
Application No.: 10/735,370 : Group Art Unit: 1762
Filed: December 12, 2003 : Examiner: K. BAREFORD
:

For: ARTICLE PROTECTED BY A THERMAL BARRIER COATING HAVING A CERIUM OXIDE-ENRICHED SURFACE PRODUCED BY PRECURSOR INFILTRATION

SECOND APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Applicant files its Appeal Brief, together with a Fee Transmittal authorizing the charging of the required fee. A Notice of Appeal and fee were previously filed.

Real party in interest

The real party in interest is General Electric Co.

Related appeals and interferences

There was a previous decision on the first appeal in this case, dated August 24, 2006. A copy of the Decision on Appeal is found in Appendix III.

Status of claims

Claims 1-17 were filed.

During prosecution, claims 1, 9, and 13 were amended, and claims 8 and 12 were cancelled. Claims 1-7, 9-11, and 13-17 were finally rejected in a Final Office Action dated

July 11, 2005. The final rejection of claims 1-7, 9-11, and 13-17 were appealed in the first Appeal Brief.

In the decision on the first appeal, the rejection of claims 13-17 was affirmed, and the rejection of claims 1-7 and 9-11 was reversed.

The Examiner then issued a new Non-Final Office Action on November 13, 2006. Claims 1, 9, and 13 were amended, and new claims 18-21 were added.

There was a Final Office Action of February 6, 2007, finally rejecting claims 1-7, 9-11, and 13-21. Applicant did not respond, but instead filed a second notice of appeal.

Status of amendments

No response to the final rejection was filed.

Summary of claimed subject matter

There are four independent claims 1, 9, 13, and 19. There are no means claims.

The invention of claim 1 is discussed in para. [0018]-[0030] of the Specification and illustrated in Figures 1, 3, and 4.

According to the present approach as recited in claim 1, a method for preparing a protected article comprises first providing the article, step 20 of Figure 1. p.4, line 9. An example of an article 40 to be protected is a gas turbine blade 42, illustrated generally in Figure 1 and in detail with the various coatings in Figures 3 and 4. A bond coat 60 is deposited onto an exposed surface 62 of the article 40, step 22 of Figure 1. p.5, lines 15-19. A thermal barrier coating 64 is produced on an exposed surface 66 of the bond coat 60, step 24 of Figure 1. p.7, lines 6-7. The step 24 of producing the thermal barrier coating 64 includes the steps of depositing a primary ceramic coating 68 onto the exposed surface 66 of the bond coat 60, step 26 of Figure 1. p.7, lines 7-9. A surface of the primary ceramic coating 68 comprises columnar grains 70 having facing surfaces 72 (see Figure 4). p.7, lines 24-25. This completes the deposition of the basic thermal barrier coating system, but the primary ceramic coating 68 would be subject to degradation by sintering mechanisms, but for the following steps.

To reduce the adverse effects of the sintering, a cerium-oxide-precursor compound 78 is then deposited, step 28 of Figure 1, onto the facing surfaces 72 of the columnar grains 70 of the primary ceramic coating 68. p.8, lines 22-25. The cerium-oxide-precursor compound 78 may not be cerium oxide with cerium in a +4 oxidation state. The cerium-

oxide-precursor compound 78 is then heated in an oxygen-containing atmosphere to form cerium oxide with cerium in the +4 oxidation state adjacent to the facing surfaces 72 of the primary ceramic coating 68 and leaving air-filled gaps 74 between the facing surfaces 72 of the columnar grains 70, step 30 of Figure 1. p.9, lines 5-9.

The invention of claim 9 is discussed in para. [0018]-[0030] of the Specification and illustrated in Figures 1, 3, and 4.

As recited in claim 9, a method for preparing a protected article comprises the steps of providing a nickel-base superalloy article 40 that is a component of a gas turbine engine, step 20 of Figure 1. p.4, lines 21-23. A bond coat 60 is deposited onto an exposed surface 62 of the article 60, step 22 of Figure 1. p.5, lines 15-19. A thermal barrier coating 64 is deposited on an exposed surface 66 of the bond coat 60, step 24 of Figure 1. p.7, lines 6-7. The step 24 of producing the thermal barrier coating includes the steps of depositing a yttria-stabilized zirconia primary ceramic coating 68 in a columnar form (see the columnar grains 70 depicted in Figure 4) onto the exposed surface 66 of the bond coat 60, step 28, and infiltrating a cerium-oxide-precursor compound 78 from an exposed surface 72 of the primary ceramic coating 68 into the primary ceramic coating 68. p.7, lines 7-15. The cerium-oxide-precursor compound 78 is not cerium oxide with cerium in a +4 oxidation state. The cerium-oxide-precursor compound 78 is heated to form cerium oxide with cerium in the +4 oxidation state adjacent to the exposed surface 72 of the primary ceramic coating 68. p. 9, lines 5-9.

The invention of claim 13 is discussed in para. [0018]-[0030] of the Specification and illustrated in Figures 1, 3, and 4.

As recited in claim 13, a method for preparing a protected article comprises the steps of providing the article 40, step 20, (p.4, line 9) depositing a bond coat 60 onto an exposed surface 62 of the article, step 22, (p.5, lines 15-19) and producing a thermal barrier coating on an exposed surface 66 of the bond coat 60 (p.7, lines 6-7). The thermal barrier coating comprises a primary ceramic coating 68 on the exposed surface 66 of the bond coat 60, and a sintering-inhibitor region at a surface 72 of the primary ceramic coating 68. p.9, lines 25-27. A surface of the primary ceramic coating 68 comprises columnar grains 70 with facing surfaces 72 (see Figure 4). The primary ceramic coating 68 has an excess of oxygen vacancies. p.3, lines 18-20. The sintering-inhibitor region comprises cerium oxide with cerium in the +4 oxidation state in a concentration greater than a general cerium oxide concentration in the primary ceramic coating. p.7, lines 27-28.

The invention of claim 19 is discussed in para. [0018]-[0030] of the Specification and illustrated in Figures 1, 3, and 4.

As recited in claim 19, a method for preparing a protected article comprises the steps of providing the article 40, step 20, (p.4, line 9) depositing a bond coat 60 onto an exposed surface 62 of the article 40, step 22, (p.5, lines 15-19) and producing a thermal barrier coating 64 on an exposed surface 66 of the bond coat 60, step 24 (p.7, lines 6-7). The thermal barrier coating 64 comprises a primary ceramic coating 68 on the exposed surface 66 of the bond coat 60, wherein the primary ceramic coating 68 has an excess of oxygen vacancies therein (p3., lines 18-20), and a sintering-inhibitor region at a surface 72 of the primary ceramic coating 68. p.9, lines 27-28. The sintering-inhibitor region removes oxygen vacancies from the primary ceramic coating 68. p.9, lines 20-21.

Grounds of rejection to be reviewed on appeal

Ground 1. Claims 13-21 are rejected under 35 USC 112, first paragraph.

Ground 2. Claims 13-21 are rejected under 35 USC 103 over Subramanian U.S. Patent 6,296,945 in view of Stoffer U.S. Patent 5,932,083.

Ground 3. Claims 1-5, 7, 9, 10, and 13-21 are rejected under 35 USC 103 over Villiger U.S. Publication 2001/003631 in view of Subramanian '082 and Liu Article.

Ground 4. Claims 6 and 11 are rejected under 35 USC 103 as unpatentable over Villiger '631 in view of Subramanian '082 and Liu Article, and further in view of Ueda U.S. Patent 5,697,992.

Ground 5. Claim 10 is rejected under 35 USC 103 over Villiger '631 in view of Subramanian '082 and Liu Article, and further in view of Taylor U.S. Patent 5,520,516.

Ground 6. Claims 1-5, 7, 9, 10, and 13-21 are rejected under 35 USC 103 as unpatentable over Villiger '631 in view of Taylor '516 and Liu Article.

Ground 7. Claims 6 and 11 are rejected under 35 USC 103 as unpatentable over Villiger '631 in view of Taylor '516 and Liu Article, and further in view of Ueda '992.

Ground 8. Claims 19-21 are rejected under 35 USC 103 as unpatentable over Villiger '631 in view of Vine '618 and Liu Article

Argument

The subject matter of the inventions is complex, and some background is helpful to understand the nature of the invention in its technical context.

Background of the Invention

A thermal barrier coating system may be used to protect the components of a gas turbine engine that are subjected to the highest temperatures. The thermal barrier coating system may include a bond coat that is deposited upon a superalloy substrate, and a ceramic thermal barrier coating that is deposited upon the bond coat. The thermal barrier coating acts as a thermal insulator against the heat of the hot combustion gas. The bond coat bonds the thermal barrier coating to the substrate and also inhibits oxidation and corrosion of the substrate. (Specification, para. [0002])

The currently preferred thermal barrier coating is yttria-stabilized zirconia (YSZ), which is zirconia (zirconium oxide) with from about 2 to about 12 percent by weight yttria (yttrium oxide) added. The yttria is present to stabilize the zirconia against phase changes that otherwise occur as the thermal barrier coating is heated and cooled during fabrication and service. The YSZ is deposited by a physical vapor deposition process such as electron beam physical vapor deposition. In this deposition process, the grains of the YSZ form as columns extending generally outwardly from and perpendicular to the surfaces of the substrate and the bond coat. [Specification, para. [0003]]

When the YSZ is initially deposited, there are small gaps between the generally columnar grains. On examination at high magnification, the generally columnar grains are seen to have a somewhat feather-like morphology characterized by these gaps oriented over a range of angles relative to the substrate surface. The gaps serve to accommodate the transverse thermal expansion strains of the columnar grains and also act as an air insulator in the insulator structure. As the YSZ is exposed to elevated temperatures during service, these gaps close by a surface-diffusion sintering mechanism. As a result, the ability of the YSZ to accommodate thermal expansion strains is reduced, and the thermal conductivity of the YSZ increases by about 20 percent or more. The as-deposited thickness of the YSZ must therefore be greater than would otherwise be desired, to account for the loss of insulating capability associated with this rise in thermal conductivity during service. [Specification, para. [0004]]

It has been recognized that the addition of sintering inhibitors to the YSZ reduces the tendency of the gaps between the columnar grains to close by sintering during service of the thermal barrier coating. A number of sintering inhibitors have been proposed. However, these sintering inhibitors have various shortcomings, and prior to the present invention there was a need for more effective sintering inhibitors. [Specification, para. [0005]]

The present invention deals with a specific sintering inhibitor, and the particular structure with which it is used.

A key feature in all of the claims is that cerium oxide with cerium in the +4 oxidation state is present at the surface of the primary ceramic coating. As stated in para. [0012] of the specification:

“The cerium-oxide-precursor compound reacts to form cerium (+4) oxide, CeO₂, rather than a more-complex compound such as a perovskite or a pyrochlore. When yttria is added to zirconia, it produces an excess of oxygen vacancies, which allows oxygen to rapidly diffuse through the thermal barrier coating. The formation of CeO₂ with cerium in the +4 valence state acts to remove the oxygen vacancies to thereby slow the diffusion of oxygen anions through the ceramic. The reduction in oxygen diffusion impedes the sintering behavior of the ceramic structure. Sintering is a surface-diffusion-related phenomenon, and the cerium oxide provides a sinter-inhibiting layer at the surface of the primary ceramic coating rather than distributed throughout the primary ceramic coating.”

That is, the cerium oxide with Ce in the +4 oxidation state yields specific benefits in terms of the subsequent performance of the product.

The Substantive Rejections

Ground 1. Claims 13-21 are rejected under 35 USC 112, first paragraph.

The basis of the rejection is that “The claim(s) contain subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.”

Claim 13 recites in part:

“a primary ceramic coating on the exposed surface of the bond coat, wherein a surface of the primary ceramic coating comprises columnar grains with facing surfaces, and wherein the primary ceramic coating has an excess of oxygen vacancies therein, and

a sintering-inhibitor region at a surface of the primary ceramic coating, wherein the sintering-inhibitor region comprises cerium oxide with cerium in an oxidation state that removes oxygen vacancies from the primary ceramic coating and in a concentration greater than a general cerium oxide concentration in the primary ceramic coating, and wherein there are air-filled gaps between the facing surfaces of the columnar grains.”

Claim 13 thus recites that where the primary ceramic coating has an excess of oxygen vacancies therein, cerium is provided in an oxidation state that removes oxygen vacancies from the primary ceramic coating.

This recited approach is disclosed at para. [0012] and para. [0030] of the Specification. At para. [0012], the present Specification discloses this limitation in the context of a preferred embodiment:

“When yttria is added to zirconia, it produces an excess of oxygen vacancies which allows oxygen to rapidly diffuse through the thermal barrier coating. The formation of CeO₂ or other +4 cerium oxide acts to remove the oxygen vacancies to thereby slow the diffusion of oxygen anions through the ceramic. The reduction in oxygen diffusion impedes the sintering behavior of the ceramic structure. The CeO₂ sintering inhibitor thereby slows and preferably prevents the sintering process which reduces and eventually eliminates the gaps 74.”

The person of ordinary skill is placed in possession of the recited invention by this disclosure. The person of ordinary skill understands that cerium oxide in the proper oxidation state acts to eliminate excess vacancies from the ceramic having such excess vacancies. The rejection seeks to limit the claimed invention to the preferred embodiment, and there is no basis for such a narrowing.

The Examiner argues that the recitation of claim 13 allows for other oxidation states of the cerium to be used, such as the +3 oxidation state. Applicant is not aware that the +3 oxidation state of cerium is “an oxidation state that removes oxygen vacancies from the primary ceramic coating”, and the Examiner has not provided any basis for asserting that a person of ordinary skill in the art will know that cerium in the +3 oxidation state will have that effect.

Ground 2. Claims 13-21 are rejected under 35 USC 103 over Subramanian US Patent 6,296,945 in view of Stoffer US Patent 5,932,083.

MPEP 2142, under ESTABLISHING A PRIMA FACIE CASE OF OBVIOUSNESS, provides: “To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine the reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant’s disclosure. [citations omitted]. See MPEP para 2143-2143.03 for decisions pertinent to each of these criteria.”

First requirement--there must be an objective basis for modifying or combining the teachings of the references

The first of the requirements of MPEP 2142 is that “there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine the reference teachings”. The present rejection is a sec. 103 combination rejection. To reach a proper teaching of an article or process through a combination of references, there must be stated an objective motivation to combine the teachings of the references, not a hindsight rationalization in light of the disclosure of the specification being examined. MPEP 2142, 2143 and 2143.01. See also, for example, In re Fine, 5 USPQ2d 1596, 1598 (at headnote 1) (Fed.Cir. 1988), In re Laskowski, 10 USPQ2d 1397, 1398 (Fed.Cir. 1989), W.L. Gore & Associates v. Garlock, Inc., 220 USPQ 303, 311-313 (Fed. Cir., 1983), and Ex parte Levingood, 28 USPQ2d 1300 (Board of Appeals and Interferences, 1993); Ex parte

Chicago Rawhide Manufacturing Co., 223 USPQ 351 (Board of Appeals 1984). As stated in In re Fine at 5 USPQ2d 1598:

"The PTO has the burden under section 103 to establish a prima facie case of obviousness. [citation omitted] It can satisfy this burden only by showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references."

And, at 5 USPQ2d 1600:

"One cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention."

Following this authority, the MPEP states that the examiner must provide such an objective basis for combining the teachings of the applied prior art. In constructing such rejections, MPEP 2143.01 provides specific instructions as to what must be shown in order to extract specific teachings from the individual references:

"Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention when there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. In re Fine, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); In re Jones, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992)."

* * * * *

"The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination." In re Mills, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990)."

* * * * *

"A statement that modifications of the prior art to meet the claimed invention would have been 'well within the ordinary skill of the art at the time the claimed invention was made' because the references relied upon teach that all aspects of the claimed invention were individually known in the art is

not sufficient to establish a *prima facie* case of obviousness without some objective reason to combine the teachings of the references. Ex parte Levingood, 28 USPQ2d 1300 (Bd.Pat.App.& Inter. 1993)."

Here, there is set forth no objective basis for combining the teachings of the references in the manner used by this rejection, and selecting the helpful portions from each reference while ignoring the unhelpful portions. An objective basis is one set forth in the art or which can be established by a declaration, not one that can be developed in light of the present disclosure.

In this case, Subramanian teaches applying a yttria-stabilized zirconia thermal barrier coating to nickel-base superalloys. Stoffer teaches applying cerium-based corrosion-protection layers to aluminum alloys. There is nothing in Subramanian that suggests that a cerium-based corrosion-protection layer, that is otherwise applied to aluminum alloys, would be applied to a yttria-stabilized thermal barrier coating.

Second requirement--there must be
an expectation of success

The second of the requirements of MPEP 2142 is an expectation of success. This requirement has not been addressed in the explanation of the rejection, and in any event more than Examiner's argument is required here. The proposed modification cannot render the reference inoperable or unsatisfactory for its intended purpose, MPEP 2142, 2143.01, and MPEP 2143.02.

As stated in MPEP 2142, "The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. [citations omitted]."

Third requirement--the prior art
must teach the claim limitations

The third of the requirements of MPEP 2142 is that "the prior art reference (or references when combined) must teach or suggest all the claim limitations." In this regard, the following principle of law applies to all sec. 103 rejections. MPEP 2143.03 provides "To establish prima facie obviousness of a claimed invention, all claim limitations must be taught

or suggested by the prior art. In re Royka, 490 F2d 981, 180 USPQ 580 (CCPA 1974). All words in a claim must be considered in judging the patentability of that claim against the prior art. In re Wilson, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970)." [emphasis added] That is, to have any expectation of rejecting the claims over a single reference or a combination of references, each limitation must be taught somewhere in the applied prior art. If limitations are not found in any of the applied prior art, the rejection cannot stand. In this case, the applied prior art references clearly do not arguably teach some limitations of the claims.

This analysis is conducted mindful of the legal standard for a section 103 rejection. Graham v. John Deere, 148 USPQ 459 (Sup. Ct., 1966) requires the following steps: (1) determine the scope and content of the prior art; (2) ascertain the differences between the prior art and the claims at issue; and (3) assess the level of skill in the art. Obviousness is determined against this background.

In determining obviousness, MPEP 706.02(j) requires (a) a statement of the relevant teachings of the prior art relied upon, preferably with reference to the relevant column or page number(s) and line number(s) where appropriate, (b) a statement of the differences in the claim over the applied references; (c) the proposed modifications to the art reference to arrive at the claimed subject matter; and (d) an explanation why one of ordinary skill in the art at the time the invention was made would have been motivated to make the proposed modification.

The explanation of the rejection completely misinterprets the combination of the teachings of Subramanian and Stoffer. Referencing col. 2, lines 35-40 of Subramanian, the explanation of the rejection concludes (Final Office Action, page 6, line 5), "The resulting applied material can be a stable oxide of C_2O_w , where C = Ce." That is not at all what Subramanian discloses and teaches. Subramanian discloses at col. 3, lines 6-9, as well as other locations (but col. 3, lines 6-9 is the most concise statement of the teaching),

"The precursor sheath oxide material consists essentially of the composition C_2O_w , where C is selected from the stable oxides that will react with the stabilized zirconia of the thermal barrier coating." [emphasis added]

So the position of the explanation of the rejection that $C = Ce$ is incorrect. C must be an oxide. The explanation of the rejection (Final Office Action, page 6, last two lines) then

goes on to identify a stable cerium oxide from the Stoffer reference as CeO_2 or Ce_2O_3 . When one of these stable oxides is substituted as C into C_zO_w , the result is $(\text{CeO}_2)_z\text{O}_w$ or $(\text{Ce}_2\text{O}_3)_z\text{O}_w$. In these electrically neutral compounds, the oxidation state of Ce cannot be +4, as a simple charge balance (with O having its normal charge of -2) shows. Nor is there any teaching in the combination of references of the limitations of the claims.

Claims 13, 15

Amended claim 13 recites in part:

“...the primary ceramic coating has an excess of oxygen vacancies therein,”

Neither reference has such a teaching. There is no mention of excess oxygen vacancies in either reference.

Claim 13 further recites in part:

“a sintering-inhibitor region at a surface of the primary ceramic coating, wherein the sintering-inhibitor region comprises cerium oxide with cerium in an oxidation state that removes oxygen vacancies from the primary ceramic coating” [emphasis added]

Neither reference has such a teaching. There is no mention of cerium in an oxidation state that removes oxygen vacancies from the primary ceramic coating in either reference. The Explanation of the rejection admits that Subramanian has no such teaching (Final Office Action, page 6, lines 16-19).

At page 7, lines 7-9, it is argued that “The use of CeO_2 ...would inherently remove oxygen vacancies...because CeO_2 is a material that inherently provides such removal from yttria stabilized zirconia.” There is no such teaching in the art, and Applicant asks for a basis for this assertion of inherency as provided in MPEP 2112-2113. Absent Applicant's own discoveries, there would be no reason to combine the teachings of the two references, neither of which has any recognition of the properties asserted to be inherent, much less the result that can be achieved by their combination. Indeed, the fact that neither reference

recognized certain properties of its own materials, much less what properties might be achieved by combining those materials is directly contrary to a finding of obviousness.

In the first full paragraph on page 7 of the Final Office Action it is argued that the oxidation state of cerium is +4 based upon the argument that "The resulting applied material can be a stable oxide of C_zO_w , where C = Ce". As discussed above, this analysis is incorrect. The correct oxides taught by the argued combination of Subramanian and Stouffer are $(CeO_2)_zO_w$ or $(Ce_2O_3)_zO_w$, in which the oxidation state of Ce cannot be +4.

Claim 14

Claim 14 depends from claim 13. The limitations of claim 13 are not taught by the combination of teachings of the references for the reasons stated above, which are incorporated here. Claim 14 is therefore also patentable over this combination of references.

Additionally, claim 14 recites in part:

"providing the article as a nickel-base superalloy article."

Stouffer teaches that the article is made of aluminum or an aluminum alloy (col. 1, lines 41-44). Subramanian mentions nickel-base superalloys, but if the teachings of Stouffer are otherwise adopted, then Stouffer's teaching of the article must also be adopted. If the teachings of Subramanian are adopted over those of Stouffer, then that is a per se hindsight reconstruction. A person of ordinary skill would not know to adopt the teachings of Stouffer over those of Subramanian.

Claim 16

Claim 16 depends from claim 13. The limitations of claim 13 are not taught by the combination of teachings of the references for the reasons stated above, which are incorporated here. Claim 16 is therefore also patentable over this combination of references.

Additionally, claim 16 recites in part:

"depositing a diffusion aluminide or an aluminum-containing overlay bond coat."

Stouffer teaches that the cerium oxide coating is applied directly to the aluminum or aluminum alloy article (col. 2, lines 61-64). Subramanian mentions bond coats, but if the teachings of Stouffer are otherwise adopted, then Stouffer's teaching of the application of the cerium oxide coating directly to the article must also be adopted. If the teachings of Subramanian are adopted over those of Stouffer, then that is a *per se* hindsight reconstruction. A person of ordinary skill would not know to adopt the teachings of Stouffer over those of Subramanian.

Claim 17

Claim 17 depends from claim 13. The limitations of claim 13 are not taught by the combination of teachings of the references for the reasons stated above, which are incorporated here. Claim 17 is therefore also patentable over this combination of references.

Additionally, claim 17 recites in part:

“depositing yttria-stabilized zirconia as the primary ceramic coating.”

Stouffer teaches that the cerium oxide coating is the primary ceramic coating that is applied directly to the aluminum or aluminum alloy article (col. 2, lines 61-64). Subramanian mentions yttria-stabilized zirconia, but if the teachings of Stouffer are otherwise adopted, then Stouffer's teaching depositing the cerium oxide as the primary ceramic coating also be adopted. If the teachings of Subramanian are adopted over those of Stouffer, then that is a *per se* hindsight reconstruction. A person of ordinary skill would not know to adopt the teachings of Stouffer over those of Subramanian.

Claim 18

Claim 18 depends from claim 13. The limitations of claim 13 are not taught by the combination of teachings of the references for the reasons stated above, which are incorporated here. Claim 18 is therefore also patentable over this combination of references.

Claim 18 further recites in part:

“forming the cerium oxide with cerium in the +4 oxidation state from a precursor compound that is not cerium oxide with cerium in a +4 oxidation state”. [emphasis added]

None of the references have such a teaching. This is a negative limitation that must be taught, as any other limitation must be taught, by the applied prior art. That it is alleged, without support, that cerium acetate is not “cerium oxide with cerium in the +4 oxidation state” (Final Office Action, page 8, lines 11-12) is not sufficient. This is a sec. 103 rejection, not a sec. 102 rejection. MPEP 2142, quoted more fully earlier, requires that “the prior art reference (or references when combined) must teach or suggest all the claim limitations.” That one example, cerium acetate, is asserted to meet this limitation is not at all a “teaching”. Nowhere do any of the applied references teach that “the cerium-oxide-precursor compound is not cerium oxide with cerium in a +4 oxidation state”.

Claims 19-20

Claim 19 recites in part:

“a primary ceramic coating on the exposed surface of the bond coat, wherein the primary ceramic coating has an excess of oxygen vacancies therein,”

Neither reference has such a teaching. There is no mention of excess oxygen vacancies in either reference. The explanation of the rejection asserts that this limitation is “inherent”, but there is no basis for that alleged inherency. Applicant incorporates the prior discussion of the inherency issue.

Claim 19 further recites in part:

“a sintering-inhibitor region at a surface of the primary ceramic coating, wherein the sintering-inhibitor region removes oxygen vacancies from the primary ceramic coating.”

Neither reference has such a teaching. There is no mention of cerium in an oxidation state that removes oxygen vacancies from the primary ceramic coating in either reference.

Claim 21

Claim 21 depends from claim 19. The limitations of claim 19 are not taught by the combination of teachings of the references for the reasons stated above, which are incorporated here. Claim 21 is therefore also patentable over this combination of references.

Additionally, claim 21 recites in part:

"the sintering-inhibitor region comprises cerium oxide with the cerium in the +4 valence state"

As demonstrated earlier, the $(CeO_2)_zO_w$ or $(Ce_2O_3)_zO_w$ compounds taught by the asserted combination of the teachings of Subramanian and Stouffer simply cannot have Ce in the +4 oxidation state. The charge balance just doesn't work out.

Ground 3. Claims 1-5, 7, 9, and 13-21 are rejected under 35 USC 103 over Villiger US Publication 2001/003631 in view of Subramanian '082 and Liu Article.

First requirement--there must be an objective basis for combining the teachings of the references

Villiger teaches closing the pores at surfaces with cerium acetate solution. The cerium acetate solution penetrates into certain small pores, fills them, and closes them off (para. [0014]-[0015]). The purpose of Villiger's approach is to inhibit corrosion of the sealed material (para. [0002]). Villiger has no teaching of sintering inhibition or taking any action to inhibit sintering. Subramanian teaches applying a C_zO_w coating such as $(CeO_2)_zO_w$ or $(Ce_2O_3)_zO_w$ to a surface of a thermal barrier layer, without sealing the surface, for sintering inhibition. These are different and inconsistent objectives, and different and inconsistent results.

The explanation of the rejection itself clearly explains why the proposed combination of teachings would not be suggested to a person of ordinary skill. In the sentence bridging pages 8-9 of the Final Office Action, the Examiner observes that Villiger teaches that large pores would not be closed and sealed off, leaving air-filled gaps between the facing surfaces. This conclusion is derived from the teaching of Villiger found in para. [0032]:

“Closed and large pores can however not be sealed off.” The point of the explanation of the rejection is that Villiger’s approach is not operable to seal pores when the pores are large.

The explanation of the rejection then says that it would be obvious to modify Villiger with the teachings of Subramanian so that the thermal barrier coating is in the form of columnar grains with facing surfaces (Final Office Action, page 11, lines 4-6. The necessary connection to try to meet the claim language is that the columnar grains of Subramanian are so large that the spaces between them are not sealed. This argument is necessary because the claims recite that there is a gap left between them in the present approach. Thus, to try to meet the claim limitation “leaving air-filled gaps between the facing surfaces of the columnar grains”, the explanation of the rejection assumes (without any basis at all in fact) that the spaces between the columnar grains of Subramanian are so large that the sealing approach of Villiger cannot close them. But if this is the case, then the use of Villiger’s approach is pointless--the whole objective of Villiger, see para. [0003], is “that communicating capillary spaces of the coating are filled, i.e., sealed, for the purpose of sealing off.”

The problem with the attempt to combine these teachings is that Villiger teaches closing off and sealing pores, while the present claims recite “leaving air-filled gaps between the facing surfaces of the columnar grains”. If the pores cannot be sealed so that gaps are left between the columnar grains, as hypothesized by the explanation of the rejection for the structure of Subramanian , then a person of ordinary skill has no motivation to even attempt to use Villiger’s approach.

The explanation of the rejection recognizes the inconsistency of the approaches of Villiger and Subramanian, and tries to excuse the admitted inability to combine the teachings by speaking of “partially” filling the pores (e.g., Final Office Action, page 10, lines 5-7, referring to Figure 3 and col. 6, lines 5-20) so that gaps are left. But that discussion relates to Subramanian’s coating, not Villiger’s sealant that does not work for large pores. If the explanation of the rejection is going to shift gears and talk about Subramanian’s C_eO_w coating such as $(CeO_2)_zO_w$ or $(Ce_2O_3)_zO_w$, then, as demonstrated above, the Ce cannot be in the +4 oxidation state, another claim limitation.

As a further backstop, it is then argued that “Villiger teaches partially sealing a thermal sprayed ceramic thermal barrier coating...” (Final Office Action, sentence bridging pages 10-11). What Villiger actually teaches is that the small pores are sealed so that there is no gap between their surfaces, and that the large pores are not sealed at all (para. [0032]).

The explanation of the rejection boils down to the following inconsistency in its attempt to combine the teachings of Villiger and Subramanian: If the person of ordinary skill is to combine the teachings of Villiger and Subramanian to create a hindsight simulation of the present invention, the person must use the sealant of Villiger to meet the claim limitation “cerium in the +4 oxidation state”. But the sealant of Villiger does not work for large pores. So to meet the claim limitation “leaving air-filled gaps between the facing surfaces of the columnar grains”, the explanation of the rejection argues that the person of ordinary skill must shift over to the teachings of Subramanian of its columnar grains and its Ce_2O_w coating such as $(CeO_2)_zO_w$ or $(Ce_2O_3)_zO_w$. But then the Ce is no longer in the +4 oxidation state.

In short, you can't meet both the “gap” and “+4 oxidation state” limitations in the hypothesized combination of teachings. There is no basis for combining the teachings of the references.

Second requirement--there must be
an expectation of success

For the reasons stated in relation to the first requirement, there is no expectation of success in the combination of teachings.

Third requirement--the prior art
must teach the claim limitations

Claims 1-5, 7

Claim 1 recites in part:

“depositing a cerium-oxide-precursor compound onto the facing surfaces of the columnar grains of the primary ceramic coating, wherein the cerium-oxide-precursor compound is not cerium oxide with cerium in a +4 oxidation state” [emphasis added]

Neither reference has any such teaching. This is a negative limitation that must be taught, as any other limitation must be taught, by the applied prior art. That it is alleged, without support, that cerium acetate is not “cerium oxide with cerium in the +4 oxidation state” (Final Office Action, page 8, lines 11-12) is not sufficient. This is a sec. 103 rejection,

not a sec. 102 rejection. MPEP 2142, quoted more fully earlier, requires that “the prior art reference (or references when combined) must teach or suggest all the claim limitations.” That one example, cerium acetate, is asserted to meet this limitation is not at all a “teaching”. Nowhere do any of the applied references teach that “the cerium-oxide-precursor compound is not cerium oxide with cerium in a +4 oxidation state”.

Claim 1 further recites:

“heating the cerium-oxide-precursor compound in an oxygen-containing atmosphere to form cerium oxide with cerium in the +4 oxidation state adjacent to the facing surfaces of the primary ceramic coating and leaving air-filled gaps between the facing surfaces of the columnar grains.”
[emphasis added]

Neither reference teaching forming “cerium oxide with cerium in the +4 oxidation state”. As discussed just above, that an example falls within the claim language is not a teaching of a claim limitation. The references must affirmatively teach the limitation “cerium in the +4 oxidation state”.

Villiger teaches closing the small pores at surfaces with cerium acetate solution, so that there is no gap remaining between the facing surfaces of the pores. The cerium acetate solution penetrates into certain small pores, fills them, and closes them off (para. [0014]-[0015]). Villiger has no teaching of sintering inhibition or taking any action to inhibit sintering.

Subramanian teaches applying a C_eO_w coating such as $(CeO_2)_zO_w$ or $(Ce_2O_3)_zO_w$ to a surface of a thermal barrier layer, leaving gaps between columnar grains. The objectives and results of the two teachings are different and inconsistent.

In the sentence bridging pages 8-9 of the Final Office Action, the explanation of the rejection observes that Villiger teaches that large pores would not be closed and sealed off, leaving air-filled gaps between the facing surfaces. This conclusion is derived from the teaching of Villiger found in para. [0032]: “Closed and large pores can however not be sealed off.” The point of the explanation of the rejection is that Villiger’s approach is not operable to seal pores when the pores are large.

The explanation of the rejection then says that it would be obvious to modify Villiger with the teachings of Subramanian so that the thermal barrier coating is in the form of columnar grains with facing surfaces (Final Office Action, page 11, lines 4-6. The necessary connection to try to meet the claim language is that the columnar grains of Subramanian are so large that the spaces between them are not sealed. This argument is

necessary because the claims recite “leaving air-filled gaps between the facing surfaces of the columnar grains”. To try to meet the claim limitation “leaving air-filled gaps between the facing surfaces of the columnar grains”, the explanation of the rejection assumes (without any basis at all in fact) that the spaces between the columnar grains of Subramanian are so large that the sealing approach of Villiger cannot close them. There is no justification or this assumption. Villiger has no teaching about what a “large” pore is, and Subramanian has no teaching as to the size of the space between columnar grains.

The explanation of the rejection recognizes the inconsistency of the approaches of Villiger and Subramanian, and tries to excuse the admitted inability to combine the teachings by speaking of “partially” filling the pores (e.g., Final Office Action, page 10, lines 5-7, referring to Figure 3 and col. 6, lines 5-20) so that gaps are left. But that discussion relates to Subramanian’s coating, not Villiger’s sealant that does not work for large pores. If the explanation of the rejection is going to shift gears and talk about Subramanian’s Ce_2O_w coating such as $(CeO_2)_zO_w$ or $(Ce_2O_3)_zO_w$, then, as demonstrated above in relation to the Ground 2 rejection, the Ce cannot “form cerium oxide with cerium in the +4 oxidation state”.

In short, you can’t meet both the “gap” and “+4 oxidation state” limitations in the hypothesized combination of teachings.

Claim 9

Claim 9 recites in part:

“infiltrating a cerium-oxide-precursor compound from an exposed surface of the primary ceramic coating into the primary ceramic coating, wherein the cerium-oxide-precursor compound is not cerium oxide with cerium in a +4 oxidation state,” [emphasis added]

Neither reference has any such teaching. This is a negative limitation that must be taught, as any other limitation must be taught, by the applied prior art. That it is alleged, without support, that cerium acetate is not “cerium oxide with cerium in the +4 oxidation state” (Final Office Action, page 8, lines 11-12, is not sufficient. This is a sec. 103 rejection, not a sec. 102 rejection. MPEP 2142, quoted more fully earlier, requires that “the prior art reference (or references when combined) must teach or suggest all the claim limitations.” That one example, cerium acetate, is asserted to meet this limitation is not at all a “teaching” because absent reference to Applicant’s own invention, there’s nothing in the

references that shows the oxidation state has any importance. Nowhere does any of the applied references teach that “the cerium-oxide-precursor compound is not cerium oxide with cerium in a +4 oxidation state”.

Claim 9 further recites in part:

“heating the cerium-oxide-precursor compound to form cerium oxide with cerium in the +4 oxidation state adjacent to the exposed surface of the primary ceramic coating.” [emphasis added]

The explanation of the rejection argues that Villiger teaches this limitation. However, Subramanian is relied upon for the teaching of another claim limitation, “depositing a yttria-stabilized zirconia primary ceramic coating in a columnar form onto the exposed surface of the bond coat”. Subramanian teaches a different approach using a C_zO_w coating such as $(CeO_2)_zO_w$ or $(Ce_2O_3)_zO_w$, which as demonstrated earlier does not meet the limitation “cerium oxide with cerium in the +4 oxidation state”. If a person of ordinary skill is relying on Subramanian’s teaching for the columnar primary ceramic coating, that person can be expected to adopt Subramanian’s teaching of the C_zO_w coating such as $(CeO_2)_zO_w$ or $(Ce_2O_3)_zO_w$, which does not meet the limitation “cerium oxide with cerium in the +4 oxidation state”.

Claims 13-17

Amended claim 13 recites in part:

“...the primary ceramic coating has an excess of oxygen vacancies therein,”

None of the reference has such a teaching. There is no mention of excess oxygen vacancies in any of the references.

The explanation of the rejection argues (Final Office Action, page 8, lines 5-7) that “This primary coating would have an excess of oxygen vacancies as the use of yttria stabilized zirconia is taught, which inherently has an excess of the oxygen vacancies.”, referencing para. [0017] Para. [0017] has no mention of oxygen vacancies, either inherent or otherwise. The assertion of “inherency” is used because the prior art does not teach the claim limitation--only the present application discloses this limitation. This is an attempt to use Applicant’s own discovery and disclosure against them.

Claim 13 further recites in part:

“a sintering-inhibitor region at a surface of the primary ceramic coating, wherein the sintering-inhibitor region comprises cerium oxide with cerium in an oxidation state that removes oxygen vacancies from the primary ceramic coating” [emphasis added]

None of the reference has such a teaching. There is no mention of cerium in an oxidation state that removes oxygen vacancies from the primary ceramic coating in any of the references. The Explanation of the rejection admits that Villiger has no such teaching (Final Office Action, page 9, lines 8-10, and then does not mention the limitation again. The paragraph bridging pages 9-10 of the Final Office Action addresses this rejection as applied to claim 13. This limitation is not mentioned at all, and no asserted teaching of this limitation is present.

At page 12, lines 3-6, it is argued that “The use of CeO₂...would inherently remove oxygen vacancies...because CeO₂ is a material that inherently provides such removal from yttria stabilized zirconia.”

What is remarkable about this rejection is that the two key limitations are not even arguably present in the applied art. Instead, they are argued to be “inherently” present, without any basis.

In the first full paragraph on page 7 of the Final Office Action it is argued that the oxidation state of cerium is +4 in Subramanian based upon the argument that “The resulting applied material can be a stable oxide of C_zO_w, where C = Ce”. As discussed above in relation to the Ground 2 rejection, this analysis is incorrect. The correct oxides taught by Subramanian is (CeO₂)_zO_w or (Ce₂O₃)_zO_w, in which the oxidation state of Ce cannot be +4.

Claim 18

Claim 18 depends from claim 13. The limitations of claim 13 are not taught by the combination of teachings of the references for the reasons stated above, which are incorporated here. Claim 18 is therefore also patentable over this combination of references.

Claim 18 further recites in part:

“forming the cerium oxide with cerium in the +4 oxidation state from a precursor compound that is not cerium oxide with cerium in a +4 oxidation state”. [emphasis added]

None of the references have such a teaching. This is a negative limitation that must be taught, as any other limitation must be taught, by the applied prior art. That it is alleged, without support, that cerium acetate is not “cerium oxide with cerium in the +4 oxidation state” (Final Office Action, page 8, lines 11-12) is not sufficient. This is a sec. 103 rejection, not a sec. 102 rejection. MPEP 2142, quoted more fully earlier, requires that “the prior art reference (or references when combined) must teach or suggest all the claim limitations.” That one example, cerium acetate, is asserted to meet this limitation is not at all a “teaching”. Nowhere do any of the applied references teach that “the cerium-oxide-precursor compound is not cerium oxide with cerium in a +4 oxidation state”.

Claims 19-20

Claim 19 recites in part:

“a primary ceramic coating on the exposed surface of the bond coat, wherein the primary ceramic coating has an excess of oxygen vacancies therein,”

None of the references has such a teaching. There is no mention of excess oxygen vacancies in any of the references. The explanation of the rejection asserts that this limitation is “inherent”, but there is no basis for that alleged inherency. Applicant incorporates the prior discussion of the inherency issue.

Claim 19 further recites in part:

“a sintering-inhibitor region at a surface of the primary ceramic coating, wherein the sintering-inhibitor region removes oxygen vacancies from the primary ceramic coating.”

Neither reference has such a teaching. There is no mention of cerium in an oxidation state that removes oxygen vacancies from the primary ceramic coating in either reference.

Claim 21

Claim 21 depends from claim 19. The limitations of claim 19 are not taught by the combination of teachings of the references for the reasons stated above, which are incorporated here. Claim 21 is therefore also patentable over this combination of references.

Additionally, claim 21 recites in part:

"the sintering-inhibitor region comprises cerium oxide with the cerium in the +4 valence state"

As demonstrated earlier, the $(CeO_2)_zO_w$ or $(Ce_2O_3)_zO_w$ compounds taught by the asserted combination of the teachings of Subramanian and Stouffer simply cannot have Ce in the +4 oxidation state. The charge balance just doesn't work out.

Ground 4. Claims 6 and 11 are rejected under 35 USC 103 as unpatentable over Villiger '631 in view of Subramanian '082 and Liu Article, and further in view of Ueda US Patent 5,697,992.

Ueda is nonanalogous art. Stated alternatively, Ueda is not within the scope and content of the prior art that may be used in forming a sec. 103 rejection. Its teachings are therefore not properly combined with the teachings of Subramanian. To be analogous art and properly used in forming a sec. 103 rejection, a reference must be concerned with the same problem as another reference and the claims which are being addressed. See, for example, Medtronic, Inc. v. Cardiac Pacemaker, Inc., 220 USPQ 97, 104 (Fed. Cir. 1983), stating: "Faced with a rate-limiting problem, one of ordinary skill in the art would look to the solutions of others faced with rate-limiting problems."

In the present case, the inventor was concerned with thermal barrier coatings such as those applied to turbine blades and other structures, see the Background section of the Specification, and applying a sintering inhibiting coating. Villiger and Subramanian was also arguably concerned with thermal barrier coatings.

Ueda deals with abrasive particles, see col. 1, lines 7-11, and has absolutely nothing to do with thermal barrier coatings or similar structures. Ueda never mentions thermal barrier coatings or anything remotely similar. Ueda also does not apply a cerium-containing

coating to anything, for sintering inhibition or anything else. Ueda mixes cerium oxide with aluminum oxide and silicon oxide (col. 2, lines 36-41), and does not use the cerium oxide as a coating.

Ueda is therefore not properly within the scope of the prior art. A person seeking to improve thermal barrier coatings or apply a sintering-inhibition coating would have no motivation to extract any abrasive teachings from Ueda and attempt to apply them to the technology of thermal barrier coatings. It is therefore not properly applied in rejecting the present claims.

But, if Ueda is applied in forming the rejection, the combination of teachings still does not teach the present claim limitations.

First requirement--there must be an objective basis for combining the teachings of the references

There is no objective basis for combining the teachings of Villiger, Subramanian, and Liu, for the reasons stated earlier in relation to the Ground 3 rejection, and which are incorporated here. There is also no objective basis for combining the teachings of Ueda. Ueda deals with abrasive particles, not thermal barrier coatings. Ueda does not apply a cerium oxide coating, but instead mixes the cerium oxide with aluminum oxide and silicon oxide. Ueda does not apply a coating to a surface. If the teaching of Ueda regarding $(\text{NH}_4)\text{Ce}(\text{SO}_4)_3$ is adopted, then the teaching of Ueda of mixing the $(\text{NH}_4)\text{Ce}(\text{SO}_4)_3$ with aluminum oxide and silicon oxide must also be adopted, and the combined teaching becomes one of mixed-ceramic particles with no coating thereon.

Second requirement--there must be an expectation of success

There is no expectation of success for the reasons stated earlier in relation to the Ground 3 rejection, and which are incorporated here.

Third requirement--the prior art must teach the claim limitations

Claim 6

Claim 6 depends from claim 1. The limitations of claim 1 are not taught by the combination of teachings of the references for the reasons stated above, which are incorporated here. Ueda adds nothing in this regard. Claim 6 is therefore also patentable over this combination of references.

Additionally, claim 6 recites in part:

“depositing a cerium-oxide-precursor compound onto the facing surfaces of the columnar grains of the primary ceramic coating, wherein the cerium-oxide-precursor compound is not cerium oxide with cerium in a +4 oxidation state, wherein the step of depositing the cerium-oxide-precursor compound includes the step of furnishing $(NH_4)Ce(SO_4)_3$ as the cerium-oxide-precursor compound” [underlined portion from claim 6, remainder from parent claim 1]

None of the references teaches depositing $(NH_4)Ce(SO_4)_3$ onto a surface. If the teaching of Ueda as to $(NH_4)Ce(SO_4)_3$ is adopted, then the teaching of Ueda that the $(NH_4)Ce(SO_4)_3$ must be mixed with aluminum oxide and silicon oxide must also be adopted.

Claim 11

Claim 11 depends from claim 9. The limitations of claim 9 are not taught by the combination of teachings of the references for the reasons stated above, which are incorporated here. Ueda adds nothing in this regard. Claim 11 is therefore also patentable over this combination of references.

Additionally, claim 11 recites in part:

“the step of depositing the cerium-oxide-precursor compound includes the step of furnishing $(NH_4)Ce(SO_4)_3$ as the cerium-oxide-precursor compound”

None of the references teaches depositing $(NH_4)Ce(SO_4)_3$ onto a surface. If the teaching of Ueda as to $(NH_4)Ce(SO_4)_3$ is adopted, then the teaching of Ueda that the $(NH_4)Ce(SO_4)_3$ must be mixed with aluminum oxide and silicon oxide must also be adopted.

Ground 5. Claim 10 is rejected under 35 USC 103 over Villiger '631 in view of Subramanian '082 and Liu Article, and further in view of Taylor US Patent 5,520,516.

Claim 10 depends from claim 9, and incorporates its limitations. The combination of Villiger, Subramanian, Liu does not teach these limitations for the reasons stated above, and which are incorporated here. Taylor adds nothing in this regard. Claim 9 is patentable over this ground of rejection, as is claim 10.

Ground 6. Claims 1-5, 7, 9, 10, and 13-21 are rejected under 35 USC 103 as unpatentable over Villiger '631 in view of Taylor '516 and Liu Article.

First requirement--there must be an objective basis for combining the teachings of the references

Villiger teaches closing the pores at surfaces with cerium acetate solution. The cerium acetate solution penetrates into certain small pores, fills them, and closes them off (para. [0014]-[0015]). The purpose of Villiger's approach is to inhibit corrosion of the sealed material (para. [0002]). Villiger has no teaching of sintering inhibition or taking any action to inhibit sintering. On the other hand, Villager teaches (page. [0032]) that "Closed and large pores can however not be sealed off." That is, Villager's approach is inoperable if the pores are large.

Taylor teaches making a "macrocracked" layer. According to Taylor (col. 4, lines 58-61), "The width of the vertical macrocracks, i.e., the distance between opposing faces defining the vertical macrocracks, is generally less than about 1 mil, preferably less than 1/2 mil."

In deciding whether there is an objective basis for combining the teachings, a key question is whether the macrocracks of Taylor are "small", so that they are filled and sealed by the Villager approach, or "large", so that they are not filled and sealed, and therefore Villager's approach is inoperable.

The explanation of the rejection has not indicated which of these alternatives is the case. But if the Taylor macrocracks are "small" so that they filled by Villager's seal material, then there is no gap between the facing surfaces of the columnar grains. If the Taylor macrocracks are "large", so that they are not filled by Villager's seal material, then the Villager approach is inoperable and there is no reason to attempt to combine the teachings.

The problem with the attempt to combine these teachings is that Villiger teaches closing off and sealing pores, while the present claims recite "leaving air-filled gaps between the facing surfaces of the columnar grains". If the pores cannot be sealed so that gaps are left between the columnar grains, as hypothesized by the explanation of the rejection for the structure of Taylor, then a person of ordinary skill has no motivation to even attempt to use Villiger's approach.

The inconsistency facing the attempt to form the hindsight reconstruction of the invention is that Villager only works for filling and sealing small pores. But if the small pores are filled and sealed, then there is no gap between the columns as recited in the claims.

Second requirement--there must be
an expectation of success

For the reasons stated in relation to the first requirement, there is no expectation of success in the combination of teachings.

Third requirement--the prior art
must teach the claim limitations

Claims 1-5, 7

Claim 1 recites in part:

"depositing a cerium-oxide-precursor compound onto the facing surfaces of the columnar grains of the primary ceramic coating, wherein the cerium-oxide-precursor compound is not cerium oxide with cerium in a +4 oxidation state" [emphasis added]

Neither reference has any such teaching. This is a negative limitation that must be taught, as any other limitation must be taught, by the applied prior art. That it is alleged, without support, that cerium acetate is not "cerium oxide with cerium in the +4 oxidation state" (Final Office Action, page 8, lines 11-12) is not sufficient. This is a sec. 103 rejection, not a sec. 102 rejection. MPEP 2142, quoted more fully earlier, requires that "the prior art

reference (or references when combined) must teach or suggest all the claim limitations.” That one example, cerium acetate, is asserted to meet this limitation is not at all a “teaching”. Nowhere do any of the applied references teach that “the cerium-oxide-precursor compound is not cerium oxide with cerium in a +4 oxidation state”.

Claim 1 further recites:

“heating the cerium-oxide-precursor compound in an oxygen-containing atmosphere to form cerium oxide with cerium in the +4 oxidation state adjacent to the facing surfaces of the primary ceramic coating and leaving air-filled gaps between the facing surfaces of the columnar grains.”
[emphasis added]

Neither reference teaching forming “cerium oxide with cerium in the +4 oxidation state”. As discussed just above, that an example falls within the claim language is not a teaching of a claim limitation in a sec. 103 rejection--there must be a teaching. The references must affirmatively teach the limitation “cerium in the +4 oxidation state”.

Villiger teaches closing the small pores at surfaces with cerium acetate solution, so that there is no gap remaining between the facing surfaces of the pores. The cerium acetate solution penetrates into certain small pores, fills them, and closes them off (para. [0014]-[0015]). Villiger has no teaching of sintering inhibition or taking any action to inhibit sintering.

Taylor teaches making a “macrocracked” layer. According to Taylor (col. 4, lines 58-61), “The width of the vertical macrocracks, i.e., the distance between opposing faces defining the vertical macrocracks, is generally less than about 1 mil, preferably less than 1/2 mil.”

The explanation of the rejection presents an argument as to how these two teachings are to be combined, but in the end the argument falls apart. At page 15, lines 14-18, the explanation of the rejection observes that Villiger teaches that large pores would not be closed and sealed off, leaving air-filled gaps between the facing surfaces. This conclusion is derived from the teaching of Villiger found in para. [0032]: “Closed and large pores can however not be sealed off.” The point of the explanation of the rejection is that Villiger’s approach is not operable to seal pores when the pores are large.

The explanation of the rejection then says that it would be obvious to modify Villiger with the teachings of Taylor so that the thermal barrier coating is in the form of columnar grains with facing surfaces (Final Office Action, sentence bridging pages 17-18). The

necessary connection to try to meet the claim language is that the columnar grains of Taylor are so large that the spaces between them are not sealed. This argument is necessary because the claims recite “leaving air-filled gaps between the facing surfaces of the columnar grains”. To try to meet the claim limitation “leaving air-filled gaps between the facing surfaces of the columnar grains”, the explanation of the rejection assumes (without any basis at all in fact) that the spaces between the columnar grains of Taylor are so widely spaced that the sealing approach of Villiger cannot close them. There is no justification or this assumption. Villiger has no teaching about what a “large” pore is.

But in any event, if the corrosion-protection coating of Villiger does not fill the pores so that gaps are left, the corrosion-protection coating of Villager is inoperable. MPEP 2143.01 provides that, in constructing a sec. 103 rejection, the proposed modification cannot render the prior art unsatisfactory for its intended purpose or change the principle of operation of a reference. MPEP 2142 and 2143.02 require that, in combining the teachings of two references, there must be a reasonable expectation of success in the combination. Both of these mandates would be violated in the proposed approach of using the technique of Villager with pores that are sufficiently large that there are gaps left.

Claim 9

Claim 9 recites in part:

“infiltrating a cerium-oxide-precursor compound from an exposed surface of the primary ceramic coating into the primary ceramic coating, wherein the cerium-oxide-precursor compound is not cerium oxide with cerium in a +4 oxidation state” [emphasis added]

Neither reference has any such teaching. This is a negative limitation that must be taught, as any other limitation must be taught, by the applied prior art. That it is alleged, without support, that cerium acetate is not “cerium oxide with cerium in the +4 oxidation state” (Final Office Action, page 8, lines 11-12) is not sufficient. This is a sec. 103 rejection, not a sec. 102 rejection. MPEP 2142, quoted more fully earlier, requires that “the prior art reference (or references when combined) must teach or suggest all the claim limitations.” That one example, cerium acetate, is asserted to meet this limitation is not at all a “teaching”. Nowhere do any of the applied references teach that “the cerium-oxide-precursor compound is not cerium oxide with cerium in a +4 oxidation state”.

Claim 9 further recites:

“heating the cerium-oxide-precursor compound to form cerium oxide with cerium in the +4 oxidation state adjacent to the exposed surface of the primary ceramic coating”

Neither reference teaching forming “cerium oxide with cerium in the +4 oxidation state”. As discussed just above, that an example falls within the claim language is not a teaching of a claim limitation in a sec. 103 rejection--there must be a teaching. The references must affirmatively teach the limitation “cerium in the +4 oxidation state”.

Claims 13-17

Amended claim 13 recites in part:

“...the primary ceramic coating has an excess of oxygen vacancies therein,”

None of the references has such a teaching. There is no mention of excess oxygen vacancies in any of the references.

The explanation of the rejection argues (Final Office Action, page 15, lines 1-3) that “This primary coating would have an excess of oxygen vacancies as the use of yttria stabilized zirconia is taught, which inherently has an excess of the oxygen vacancies.”, referencing para. [0017] Para. [0017] has no mention of oxygen vacancies, either inherent or otherwise. The assertion of “inherency” is used because the prior art does not teach the claim limitation--only the present application discloses this limitation. This is an attempt to use Applicant’s own discovery and disclosure against them.

Claim 13 further recites in part:

“a sintering-inhibitor region at a surface of the primary ceramic coating, wherein the sintering-inhibitor region comprises cerium oxide with cerium in an oxidation state that removes oxygen vacancies from the primary ceramic coating” [emphasis added]

None of the references teaches “a sintering-inhibitor region”. None of the reference mentions the inhibition of sintering at all.

None of the reference has such a teaching of removing the oxygen vacancies. There is no mention of cerium in an oxidation state that removes oxygen vacancies from the primary ceramic coating in any of the references. The Explanation of the rejection admits that Villiger has no such teaching (Final Office Action, page 16, lines 4-6).

At page 18, lines 18-20, it is argued that “The use of CeO₂...would inherently remove oxygen vacancies...because CeO₂ is a material that inherently provides such removal from yttria stabilized zirconia.” There is no such teaching in the art, and Applicant asks for a basis for this assertion of inherency as provided in MPEP 2112-2113.

What is remarkable about this rejection is that the two key limitations are not even arguably present in the applied art. Instead, they are argued to be “inherently” present, without any basis.

Claim 18

Claim 18 depends from claim 13. The limitations of claim 13 are not taught by the combination of teachings of the references for the reasons stated above, which are incorporated here. Claim 18 is therefore also patentable over this combination of references.

Claim 18 further recites in part:

“forming the cerium oxide with cerium in the +4 oxidation state from a precursor compound that is not cerium oxide with cerium in a +4 oxidation state”. [emphasis added]

None of the references have such a teaching. This is a negative limitation that must be taught, as any other limitation must be taught, by the applied prior art. That one example, cerium acetate, is asserted to meet this limitation is not at all a “teaching”. Nowhere do any of the applied references teach that “the cerium-oxide-precursor compound is not cerium oxide with cerium in a +4 oxidation state”.

Claims 19-20

Claim 19 recites in part:

“a primary ceramic coating on the exposed surface of the bond coat, wherein the primary ceramic coating has an excess of oxygen vacancies therein,”

None of the references has such a teaching. There is no mention of excess oxygen vacancies in any of the references. The explanation of the rejection asserts that this limitation is “inherent”, but there is no basis for that alleged inherency. Applicant incorporates the prior discussion of the inherency issue.

Claim 19 further recites in part:

“a sintering-inhibitor region at a surface of the primary ceramic coating, wherein the sintering-inhibitor region removes oxygen vacancies from the primary ceramic coating.”

Neither reference has such a teaching. There is no mention of cerium in an oxidation state that removes oxygen vacancies from the primary ceramic coating in either reference.

Claim 21

Claim 21 depends from claim 19. The limitations of claim 19 are not taught by the combination of teachings of the references for the reasons stated above, which are incorporated here. Claim 21 is therefore also patentable over this combination of references.

Additionally, claim 21 recites in part:

“the sintering-inhibitor region comprises cerium oxide with the cerium in the +4 valence state”

None of the references have any such teaching.

Ground 7. Claims 6 and 11 are rejected under 35 USC 103 as unpatentable over Villiger '631 in view of Taylor '516 and Liu Article, and further in view of Ueda '992.

Ueda is nonanalogous art for the reasons discussed in relation to the Ground 4 rejection, and which are incorporated here.

But, if Ueda is applied in forming the rejection, the combination of teachings still does not teach the present claim limitations.

First requirement--there must be an objective basis for combining the teachings of the references

There is no objective basis for combining the teachings of Villiger, Taylor, and Liu, for the reasons stated earlier in relation to the Ground 6 rejection, and which are incorporated here. There is also no objective basis for combining the teachings of Ueda. Ueda deals with abrasive particles, not thermal barrier coatings. Ueda does not apply a cerium oxide coating, but instead mixes the cerium oxide with aluminum oxide and silicon oxide. Ueda does not apply a coating to a surface. If the teaching of Ueda regarding $(\text{NH}_4)\text{Ce}(\text{SO}_4)_3$ is adopted, then the teaching of Ueda of mixing the $(\text{NH}_4)\text{Ce}(\text{SO}_4)_3$ with aluminum oxide and silicon oxide must also be adopted, and the combined teaching becomes one of mixed-ceramic particles with no coating thereon.

Second requirement--there must be an expectation of success

There is no expectation of success for the reasons stated earlier in relation to the Ground 3 rejection, and which are incorporated here.

Third requirement--the prior art must teach the claim limitations

Claim 6

Claim 6 depends from claim 1. The limitations of claim 1 are not taught by the combination of teachings of the references for the reasons stated above, which are

incorporated here. Ueda adds nothing in this regard. Claim 6 is therefore also patentable over this combination of references.

Additionally, claim 6 recites in part:

“depositing a cerium-oxide-precursor compound onto the facing surfaces of the columnar grains of the primary ceramic coating, wherein the cerium-oxide-precursor compound is not cerium oxide with cerium in a +4 oxidation state, wherein the step of depositing the cerium-oxide-precursor compound includes the step of furnishing $(NH_4)Ce(SO_4)_3$ as the cerium-oxide-precursor compound” [underlined portion from claim 6, remainder from parent claim 1]

None of the references teaches depositing $(NH_4)Ce(SO_4)_3$ onto a surface. If the teaching of Ueda as to $(NH_4)Ce(SO_4)_3$ is adopted, then the teaching of Ueda that the $(NH_4)Ce(SO_4)_3$ must be mixed with aluminum oxide and silicon oxide must also be adopted.

Claim 11

Claim 11 depends from claim 9. The limitations of claim 9 are not taught by the combination of teachings of the references for the reasons stated above, which are incorporated here. Ueda adds nothing in this regard. Claim 11 is therefore also patentable over this combination of references.

Additionally, claim 11 recites in part:

“the step of depositing the cerium-oxide-precursor compound includes the step of furnishing $(NH_4)Ce(SO_4)_3$ as the cerium-oxide-precursor compound”

None of the references teaches depositing $(NH_4)Ce(SO_4)_3$ onto a surface. If the teaching of Ueda as to $(NH_4)Ce(SO_4)_3$ is adopted, then the teaching of Ueda that the $(NH_4)Ce(SO_4)_3$ must be mixed with aluminum oxide and silicon oxide must also be adopted.

Ground 8. Claims 19-21 are rejected under 35 USC 103 as unpatentable over Villiger '631 in view of Vine '618 and Liu Article

First requirement--there must be an objective basis for combining the teachings of the references

Villiger teaches closing the pores at surfaces with cerium acetate solution. The cerium acetate solution penetrates into certain small pores, fills them, and closes them off (para. [0014]-[0015]). The purpose of Villiger's approach is to inhibit corrosion of the sealed material (para. [0002]). Villiger has no teaching of sintering inhibition or taking any action to inhibit sintering. On the other hand, Villager teaches (page. [0032]) that "Closed and large pores can however not be sealed off." That is, Villager's approach is inoperable if the pores are large.

Vine has no teaching of pores, large or small, in a ceramic layer. Vine has no teaching of any need to close or seal pores in a ceramic layer.

There is no reason that one skilled in the art would apply the cerium acetate solution of Villager to the article of Vine.

Second requirement--there must be an expectation of success

As there is no disclosure that Vine's material has small pores that could be closed and sealed by application of the solution of Villiger, there is no expectation of success in using a process that closes and seals small pores.

Third requirement--the prior art must teach the claim limitations

Claims 19-20

Claim 19 recites in part:

"a primary ceramic coating on the exposed surface of the bond coat, wherein the primary ceramic coating has an excess of oxygen vacancies therein,"

None of the references has such a teaching. There is no mention of excess oxygen vacancies in any of the references. The explanation of the rejection asserts that this limitation is "inherent", but there is no basis for that alleged inherency. Applicant incorporates the prior discussion of the inherency issue.

Claim 19 further recites in part:

"a sintering-inhibitor region at a surface of the primary ceramic coating, wherein the sintering-inhibitor region removes oxygen vacancies from the primary ceramic coating."

Neither reference has such a teaching. There is no mention of cerium in an oxidation state that removes oxygen vacancies from the primary ceramic coating in either reference.

SUMMARY AND CONCLUSION

Applicant asks that the Board reconsider and withdraw the rejection.

For all of the foregoing reasons, Applicant asks that the Board reverse the rejections. The Commissioner is authorized to charge any fees that may be due or credit any overpayments to the undersigned's Account Number 50-1059.

Respectfully submitted,

McNEES WALLACE & NURICK, LLC

Dated: July 17, 2007

By /Shawn K. Lepo/

Shawn Lepo
Reg. No. 50,311
100 Pine Street
P.O. Box 1166
Harrisburg, PA 17108-1166
Tel: (717) 237-5218
Fax: (717) 237-5300
Attorney for Applicant

APPENDIX I
Copy of Claims Involved in the Appeal

1. A method for preparing a protected article, comprising the steps of providing the article; depositing a bond coat onto an exposed surface of the article; and producing a thermal barrier coating on an exposed surface of the bond coat, wherein the step of producing the thermal barrier coating includes the steps of
 - depositing a primary ceramic coating onto the exposed surface of the bond coat, wherein a surface of the primary ceramic coating comprises columnar grains having facing surfaces,
 - depositing a cerium-oxide-precursor compound onto the facing surfaces of the columnar grains of the primary ceramic coating, wherein the cerium-oxide-precursor compound is not cerium oxide with cerium in a +4 oxidation state, and
 - heating the cerium-oxide-precursor compound in an oxygen-containing atmosphere to form cerium oxide with cerium in the +4 oxidation state adjacent to the facing surfaces of the primary ceramic coating and leaving air-filled gaps between the facing surfaces of the columnar grains.
2. The method of claim 1, wherein the step of providing the article includes the step of providing the article as a nickel-base superalloy article.
3. The method of claim 1, wherein step of providing the article includes the step of providing the article in the form of a component of a gas turbine engine.
4. The method of claim 1, wherein the step of depositing the bond coat includes the step of depositing a diffusion aluminide or an aluminum-containing overlay bond coat.
5. The method of claim 1, wherein the step of depositing the primary ceramic coating includes the step of depositing yttria-stabilized zirconia as the primary ceramic coating.

6. The method of claim 1, wherein the step of depositing the cerium-oxide-precursor compound includes the step of furnishing $(\text{NH}_4)\text{Ce}(\text{SO}_4)_3$ as the cerium-oxide-precursor compound.

7. The method of claim 1, wherein the step of depositing the cerium-oxide-precursor compound includes the step of infiltrating the cerium-oxide-precursor compound into the exposed surface of the primary ceramic coating,

9. A method for preparing a protected article, comprising the steps of providing a nickel-base superalloy article that is a component of a gas turbine engine;
depositing a bond coat onto an exposed surface of the article; and producing a thermal barrier coating on an exposed surface of the bond coat, wherein the step of producing the thermal barrier coating includes the steps of depositing a yttria-stabilized zirconia primary ceramic coating in a columnar form onto the exposed surface of the bond coat,
infiltrating a cerium-oxide-precursor compound from an exposed surface of the primary ceramic coating into the primary ceramic coating, wherein the cerium-oxide-precursor compound is not cerium oxide with cerium in a +4 oxidation state, and heating the cerium-oxide-precursor compound to form cerium oxide with cerium in the +4 oxidation state adjacent to the exposed surface of the primary ceramic coating.

10. The method of claim 9, wherein the step of depositing the primary ceramic coating includes the step of depositing yttria-stabilized zirconia having about 7 percent yttria by weight.

11. The method of claim 9, wherein the step of depositing the cerium-oxide-precursor compound includes the step of furnishing $(\text{NH}_4)\text{Ce}(\text{SO}_4)_3$ as the cerium-oxide-precursor compound.

13. A method for preparing a protected article, comprising the steps of providing the article;

depositing a bond coat onto an exposed surface of the article; and
producing a thermal barrier coating on an exposed surface of the bond coat, wherein
the thermal barrier coating comprises

a primary ceramic coating on the exposed surface of the bond coat, wherein
a surface of the primary ceramic coating comprises columnar grains with facing surfaces,
and wherein the primary ceramic coating has an excess of oxygen vacancies therein, and

a sintering-inhibitor region at a surface of the primary ceramic coating,
wherein the sintering-inhibitor region comprises cerium oxide with cerium in an oxidation
state that removes oxygen vacancies from the primary ceramic coating and in a
concentration greater than a general cerium oxide concentration in the primary ceramic
coating, and wherein there are air-filled gaps between the facing surfaces of the columnar
grains.

14. The method of claim 13, wherein the step of providing the article includes the
step of

providing the article as a nickel-base superalloy article.

15. The method of claim 13, wherein step of providing the article includes the
step of

providing the article in the form of a component of a gas turbine engine.

16. The method of claim 13, wherein the step of depositing the bond coat
includes the step of

depositing a diffusion aluminide or an aluminum-containing overlay bond coat.

17. The method of claim 13, wherein the step of producing the thermal barrier
coating includes the step of

depositing yttria-stabilized zirconia as the primary ceramic coating.

18. The method of claim 13, wherein the step of producing includes the step of
forming the cerium oxide with cerium in the +4 oxidation state from a precursor
compound that is not cerium oxide with cerium in a +4 oxidation state

19. A method for preparing a protected article, comprising the steps of
providing the article;

depositing a bond coat onto an exposed surface of the article; and
producing a thermal barrier coating on an exposed surface of the bond coat, wherein
the thermal barrier coating comprises

a primary ceramic coating on the exposed surface of the bond coat, wherein
the primary ceramic coating has an excess of oxygen vacancies therein, and

a sintering-inhibitor region at a surface of the primary ceramic coating,
wherein the sintering-inhibitor region removes oxygen vacancies from the primary ceramic
coating.

20. The method of claim 19, wherein the primary ceramic coating is yttria-
stabilized zirconia.

21. The method of claim 19, wherein the sintering-inhibitor region comprises
cerium oxide with the cerium in the +4 valence state.

Attorney Docket No.: 130013/11921 (21635-0116)
Application No.: 10/735,370

-42-

APPENDIX II
Evidence Entered and Relied Upon in the Appeal

None.

Attorney Docket No.: 130013/11921 (21635-0116)
Application No.: 10/735,370

-43-

APPENDIX III
Related Proceedings

A copy of the prior decision on appeal in this case is attached hereto.

The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte JOHN F. ACKERMAN,
VENKAT S. VENKATARAMANT,
IRENE T. SPITSBERG, BRETT A.R. BOUTWELL
and RAMGOPAL DAROLIA

Appeal No. 2006-2027
Application No. 10/735,370

DECIDED: AUGUST 24, 2006

Before KIMLIN, PAK, and GAUDETTE, Administrative Patent Judges.
KIMLIN, Administrative Patent Judge.

DECISION ON APPEAL

This is an appeal from the final rejection of claims 1-7, 9-11, and 13-17. Claim 1 is illustrative:

1. A method for preparing a protected article, comprising the steps of providing the article;

depositing a bond coat onto an exposed surface of the article; and

producing a thermal barrier coating on an exposed surface of the bond coat, wherein the step of producing the thermal barrier coating includes the steps of

depositing a primary ceramic coating onto the exposed surface of the bond coat,

depositing a cerium-precursor compound onto an exposed surface of the primary ceramic coating, and

heating the cerium-oxide-precursor compound in an oxygen-containing atmosphere to form cerium oxide adjacent to the exposed surface of the primary ceramic coating.

The examiner relies upon the following references in the rejections of the appealed claims:

Taylor et al. (Taylor)	5,820,516	May 28, 1996
Ueda et al. (Ueda)	5,697,992	Dec. 16, 1997
Stoffer et al. (Stoffer)	5,932,083	Aug. 3, 1999
Subramanian	US 6,296,945	Oct. 2, 2001

Appellants' claimed invention is directed to a method of protecting an article, such as a component of a gas turbine engine, that is subjected to high temperatures. The method entails forming a thermal barrier coating on the article by depositing a primary ceramic coating, depositing a cerium-oxide-precursor compound onto the primary ceramic coating, and heating the cerium-oxide-precursor compound in an oxygen atmosphere to form cerium-oxide where cerium is in the +4 oxidation state.

Appealed claims 13-17 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Subramanian in view of Stoffer.¹ Claims 13-17 also stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Subramanian in view of Stoffer. Claims

¹ This rejection subsumes the rejection of claims 13-17 under § 102 over Subramanian alone.

Appeal No. 2006-2027
Application No. 10/735,370

1-7, 9 and 11 stand rejected under 35 U.S.C. § 103 as being unpatentable over Subramanian in view of Stoffer and Ueda.² Also, claim 10 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Subramanian in view of Stoffer, Ueda and Taylor.³

Appellants do not separately argue any of the claims that are grouped in the examiner's separate rejections. Accordingly, claims 13-17 stand or fall together, as do claims 1-7, 9 and 11.

We consider first the examiner's rejection of claims 13-17 under 35 U.S.C. § 102 over Subramanian in view of Stoffer. We agree with the examiner that Subramanian, like appellants, discloses a method for protecting an article from high temperatures by providing a bond coat on the surface of the article, forming a thermal barrier coating on the bond coat, wherein the thermal barrier coating is formed by first depositing a primary ceramic coating, and then applying a sintering inhibiting material to the surface of the primary coating. The examiner also correctly finds that the sintering inhibiting region can comprise appellants' cerium-oxide. Subramanian describes a sintering inhibiting material as a

² This rejection subsumes the examiner's rejection of claims 1-7, 9 and 11 under § 103 over Subramanian in view of Ueda.

³ This rejection subsumes the examiner's rejection of claim 10 under § 103 over Subramanian in view of Ueda and Taylor.

ceramic oxide precursor of the formula Z_2O_n , wherein alumina (Al_2O_3) is the preferred precursor sheath material, but Ce_2O_3 can also be an oxide of calcium, magnesium, zirconium, yttrium, and rare earth elements, such as cerium (see column 5, lines 34 et seq.). Consequently, while we agree with the examiner that Subramanian teaches a sintering-inhibiting region that may comprise cerium-oxide, we do not find that the reference sufficiently describes cerium-oxide wherein cerium is in the +4 oxidation state within the meaning of 35 U.S.C. § 102. Manifestly, a fair amount of picking and choosing from within the reference disclosure is necessary to arrive at the claimed cerium-oxide.

However, we fully concur with the examiner that one of ordinary skill in the art would have found it obvious to select cerium-oxide with cerium in the oxidation state of +4, i.e., CeO_2 , as a precursor sheath oxide material in the invention of Subramanian. We agree with the examiner that inasmuch as Subramanian teaches the use of a stable oxide for the precursor sheath oxide, and Stoffer teaches that "[c]erium possesses highly stable oxides, CeO_2 or Ce_2O_3 , in the oxidation states of 3 and 4" (column 2, lines 50-51), we are satisfied that one of ordinary skill in the art would have selected cerium-oxide with

cerium in the oxidation state of +4 for the stable oxide of Subramanian.

Appellants cite Subramanian at column 2, lines 25-40 where cerium is not mentioned as a possible material for C in the formula C_xO_y . Relying solely upon this section of the reference, appellants make the argument that "it is apparent that component C cannot possibly be Ce, and Subramanian's C_xO_y cannot possibly be Ce_2O_3 , as argued at many locations in the Examiner's Answer" (page 3 of the reply brief, last paragraph). However, the relevant teaching of Subramanian is at column 5, lines 34 st. seq..

We now turn to the rejection of claims 1-7, 9 and 11 under 35 U.S.C. § 103 over Subramanian in view of Steffer and Ueda. We will not sustain this rejection. Appellants correctly argue that Subramanian does not teach depositing a cerium-oxide-precursor compound onto the primary ceramic coating wherein the cerium-oxide-precursor compound is not cerium-oxide with cerium in a +4 oxidation state, and then heating the cerium-oxide-precursor compound to form cerium-oxide with cerium in the +4 oxidation state. While the examiner states that Subramanian teaches that "a cerium-oxide compound can be applied to the surface of the primary cerium coating" (page 14 of answer,

second paragraph), the examiner also maintains that the reference teaches that the cerium-oxide compound is a stable one and, therefore, CeO_2 , i.e., cerium-oxide with cerium in the +4 oxidation state. Clearly, if the cerium-oxide applied to the primary ceramic coating of Subramanian is the stable CeO_2 , it is not the cerium-oxide-precursor compound of claim 1 wherein cerium is not in the +4 oxidation state. Also, whereas the heating step of claim 1 converts the precursor compound to cerium-oxide with cerium in the +4 oxidation state, the heating step of Subramanian reacts CeO_2 with the thermal barrier coating to produce "an oxide of A and C or an oxide of B and C" (column 5, lines 44-45). The examiner incorrectly states that "[w]hile later reaction of the Ce_2O_w and the primary ceramic is provided, at this point, Ce_2O_w is provided as a coating, which is all that is required by the claim" (page 16 of answer, first paragraph). As a matter of fact, however, claim 1 requires depositing a cerium-oxide-precursor compound and then heating the compound to form cerium-oxide with cerium in the +4 oxidation state. This method is neither taught nor suggested by Subramanian, and this deficiency is not remedied by the disclosure of Ueda. While Ueda teaches forming cerium-oxide by calcining ammonium cerium sulfate, Ueda is directed to an abrasive particle and would not

have suggested modifying Subramanian to perform the claimed steps of heating a deposited cerium-oxide-precursor to cerium-oxide.

The examiner's separate rejections of claim 10 under 35 U.S.C. § 103 suffers the same deficiency discussed above with respect to the § 103 rejection of claims 1-7, 9 and 11. Taylor, cited by the examiner for its teaching of a zirconia coat comprising 7 wt.% yttria, does not cure the deficiency of Subramanian.

In conclusion, based on the foregoing, the examiner's rejection of claims 1-17 under 35 U.S.C. § 102(b) is reversed, whereas the rejection of claims 13-17 under 35 U.S.C. § 103 is affirmed. The examiner's rejections of claims 1-7 and 9-11 under 35 U.S.C. § 103 are also reversed. Accordingly, the examiner's decision rejecting the appealed claims is affirmed-in-part.

Appeal No. 2006-2027
Application No. 10/735,370

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a) (iv) (effective Sept. 13, 2004).

AFFIRMED-IN-PART

Edward C. Kimlin

Edward C. Kimlin)
Administrative Patent Judge)
)

Chung J. Pak

Chung J. Pak)
Administrative Patent Judge)
)

Linda M. Gaudette

Linda M. Gaudette)
Administrative Patent Judge)
)

BOARD OF PATENT
APPEALS AND
INTERFERENCES

ECK/cam

Appeal No. 2006-2027
Application No. 10/735,370

McNees, Wallace & Nurick, LLC
100 Pine Street
P. O. Box 1166
Harrisburg, PA 17108-1166